IJBSAT

ISSN: 0975 - 4539
IJBSAT (2013), 5(1):1-8

Evaluation of Moisture Content and Particle Size Distribution of some Commercial Poultry Feeds produced in NIGERIA

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ABSTRACT
Moisture content (MC) and particle size (PS) of four poultry feed types (broiler starter, broiler finisher, grower mash and layers mash) from four commercial brands coded LF, GF, TF, and VF, giving a total of 16 commercial feed types, were studied in an experiment that lasted for three months. The moisture content ranged from 8.87 - 11.72 % indicating that the feeds will not support fungal growth under tropical storage conditions. The PS of all feed types produced by LF and TF, which are mashes were similar and did not indicate any effort by the manufacturers to address feed intake needs of birds at different ages. Percentage PS distribution for LF were 63:37, 61:39, 65:35 and 61:39 % for fine and coarse portions across starter, finisher, grower and layer feeds, respectively. The trend for TF was 51:49, 58:42, 51:49 and 52:48 % for fine and coarse portions across the same feed types. VF and GF being pelleted rations showed more variations in recognition of the feed intake needs at different ages. The coarse portions of VF and GF were 49 and 51 %, 69 and 63 %, 85 and 63 % and 64 and 81 % for starter, finisher, grower and layer feeds, respectively. The particle sizes of commercial poultry feeds studied could not be concluded to be optimal since the standard values for the country does not exist.
Keywords: Moisture content, Particle size, Commercial feed, Poultry, Nigeria.

INTRODUCTION

The main aim of nutrition is to optimize productive efficiency, but this is usually achieved when health is also optimized [1]. Thus, health and welfare are major priorities in modern nutritional practices, since optimal utilization of feed is fundamental to production efficiency and health of animals. Feed qualities among other things include appropriate particle size and moisture content of the diet fed to highly productive lines of animals. Feed quality maintenance usually includes appropriate milling of the feed ingredients, proper storage and packaging as well as proper handling during marketing of the bagged feeds at the various sales outlets from where the farmers collect to feed their animals. Particle size and water holding capacity together with bulk density also play important role in feed quality since they influence feed intake [2, 3, 4, 5] and thus the productivity of animals, especially poultry.

Thus, particle size of poultry diets is an important consideration due to its association with feed intake and development of the digestive organs of young birds [4]. Particle size reduction by grinding has been shown to increase both water holding capacity and bulk density values [7, 8]. Similarly, the extent of milling is known to influence a number of other factors of poultry production, including birds' performance and digestive tract development.

Particles size reduction is a two- step process involving the increase of number of particles and the surface area per unit volume allowing greater access to digestive enzymes [9]. Other benefits include increased ease of handling and easier mixing with other ingredients [10]. However, there are practical limits to the degree of particle size reduction as the birds may encounter difficulties in consuming very fine or coarse particles of feeds [11].

In recent years, the interest on feed particle size and moisture content has increased, as the feed industry and researchers continue to search for ways of optimizing feed utilization and improving production efficiency. Recommendations regarding optimal particle sizes and moisture content of feeds, however have been contradictory, as the results from feeding trials are confounded by a number of factors including feed physical form, complexity of the diet, grain type, grinding method, pellet quality and particle size distribution [11]. This study is designed to evaluate the moisture content and particle size distribution of some commercial poultry feeds produce in Nigeria.

MATERIALS AND METHODS

Study location: This laboratory study, which lasted for three months, was carried out at the Animal Science Laboratory of the Federal University of Technology Owerri, Imo State, Nigeria. It consisted of two stages, starting with collection of feed samples from different feed outlets, and laboratory analysis of the samples.

Samples collection: A preliminary survey was carried out to identify commercial feed sellers in Owerri urban. A list of eight commercial feed brands being sold in the city was made and the four most popular brands selected for this study. These selected brands were coded VF, TF, GF and LF. Popularity was established by a brand having up to three outlets in the

ISSN: 0975 - 4539
IJBSAT (2013), 5(1):1-8

city. The major sales depots of these feed brands were used for the feed sampling. It was ascertained that none of the batches of feeds being sampled had stayed in store for more than one week.

The selected site was visited three times across 3 months period for samples collection. During each visit, four feed types (broiler starter, broiler finisher, growers mash and layer mash) were collected. Sample collection for each feed type across different commercial brands was carried out the same day. Each feed was sampled by carefully opening the bag and collecting 0.5 kilogram of feed into a clean cellophane bag. For each type of feed, samples were collected from four bags and were later pooled and homogenized thoroughly to form a representative sample of that feed type. On the whole, 2 kilogram of each sample was collected. The cellophane bag was sealed and carefully labeled, taking note of the feed type and the brand name. Overall, 16 samples collected from 64 bags made up of 16 bags each of broiler starter, broiler finisher, grower and layer mashes of the commercial feed brands were collected (Table 1). Out of the four brands of commercial poultry feed used in this experiment, LF and TF brands were mash, while VF and GF were pelleted.

Moisture content determination: Moisture contents (MC) of the feed samples were determined on 9g of each feed sample. The sample was weighed using digital counting balance into a moisture can in duplicates and placed in an oven at 135^0C for about 2 - 3 hours until no further loss in weight was observed. The sample in the can was cooled in a desiccator before final weighing. Percentage (%) moisture content was calculated as follows:

$$\frac{\text{Loss in weight during drying}}{\text{Weight of sample before drying}} \times \frac{100}{1} = \%MC$$

Particle size determination: Four particle sizes were determined using sieve analysis. One kilogram weight of each sample was measured out and passed through <1.00, 1.18, 2.00 and >2.00mm mash sieve to determine coarse and fine particles. The particles of <1.00 and 1.18mm PS were classified as fine, while the particles with PS. of 2.00 and >2.00mm PS were classified as coarse. The values gotten from all the particle sizes were converted to percentage of initial weight of the samples.

Data analyses: Data collected were subjected to analysis of variance (ANOVA) test to determine significant differences among sample means according to [12]. Where there are significance differences between means, the means were separated using the Least Significant Difference (LSD) method.

Table 1: Sampling distribution across feed types and brands
Number of bags

Feed type	VF	TF	GF	LF	Total
Broiler starter	4	4	4	4	16
Grower mash	4	4	4	4	16
Layer mash	4	4	4	4	16
Broiler finisher	4	4	4	4	16
Total	16	16	16	16	64*

* Grand total
Number of bulk samples = 16

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Table 2: Percentage moisture content (MC) of commercial poultry feeds produced in Nigeria.

Feed type	Feed brand				
	LF	VF	GF	TF	SEM
Broiler starter	10.06[b]	9.67[b]	10.81[a]	10.59[a]	0.2577
Grower mash	10.30[b]	9.78[b]	8.97[b]	11.72[a]	0.5777
Broilers finisher	9.95[b]	9.64[b]	8.87[b]	10.67[a]	0.3528
Layers mash	9.42[b]	9.17[b]	10.47[b]	10.59[a]	0.5242

ab: Means on the same row bearing different superscript are significantly different (P<0.05).

Table 3: Percentage distribution of particle sizes in 1kg of boiler starter ration of some commercial feeds.

Feed brands	<1.00mm	1.18mm	2.00mm	>2.00mm	SEM
LF	34.00[a]	29.00[a]	28.00[a]	9.00[b]	5.4924
VF	19.00[b]	32.00[a]	22.00[b]	27.00[ab]	2.8577
GF	7.00[b]	42.00[a]	24.00[b]	27.00[ab]	7.1763
TF	17.00[b]	34.00[a]	17.00[b]	32.00[a]	4.6368

ab: Means within a column with different superscript are significantly (P<0.05) different.
SEM = Standard error of mean

Table 4: Percentage distribution of particle sizes in 1kg of broiler finisher ration of some commercial feeds.

Feed brands	<1.00mm	1.18mm	2.00mm	>2.00mm	SEM
LF	30[a]	31[a]	20[b]	19[b]	3.1885
VF	13[b]	18[b]	13[b]	56[a]	10.4003
GF	9[b]	18[b]	16[b]	57[a]	10.8397
TF	28[a]	30[a]	12[b]	30[a]	4.3588

ab: means within a column with different superscripts are significantly (P< 0. 05) different.
SEM = standard error of means

Table 6: Percentage distribution of particle sizes in 1kg of layers mash of some commercial feeds.

Feed brands	<1.00mm	1.18mm	2.00mm	>2.00mm	SEM
LF	23[b]	38[a]	20[b]	19[b]	4.42
VF	11[b]	25[b]	21[b]	43[a]	6.68
GF	5[b]	14[b]	19[b]	62[a]	12.67
TF	14[b]	38[a]	19[b]	29[ab]	5.34

ab: means within a column with different subscripts are significantly (P<0.05) different.
SEM = Standard error of means.

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Table 5: Percentage distribution of particle sizes in 1kg of Grower mash of some commercial feeds.

Feed brands	<1.00mm	1.18mm	2.00mm	>2.00mm	SEM
LF	32.00[a]	33.00[a]	15.00[b]	20.00[ab]	4.45
VF	7.00[b]	8.00[b]	10.00[b]	75.00[a]	16.6883
GF	13.00[b]	24.00[b]	17.00[b]	46.00[a]	7.36
TF	17.00[b]	34.00[a]	18.00[b]	31.00[a]	4.38

ab: Means within a column with different superscript are significantly (P<0.05) different.
SEM = Standard error of means

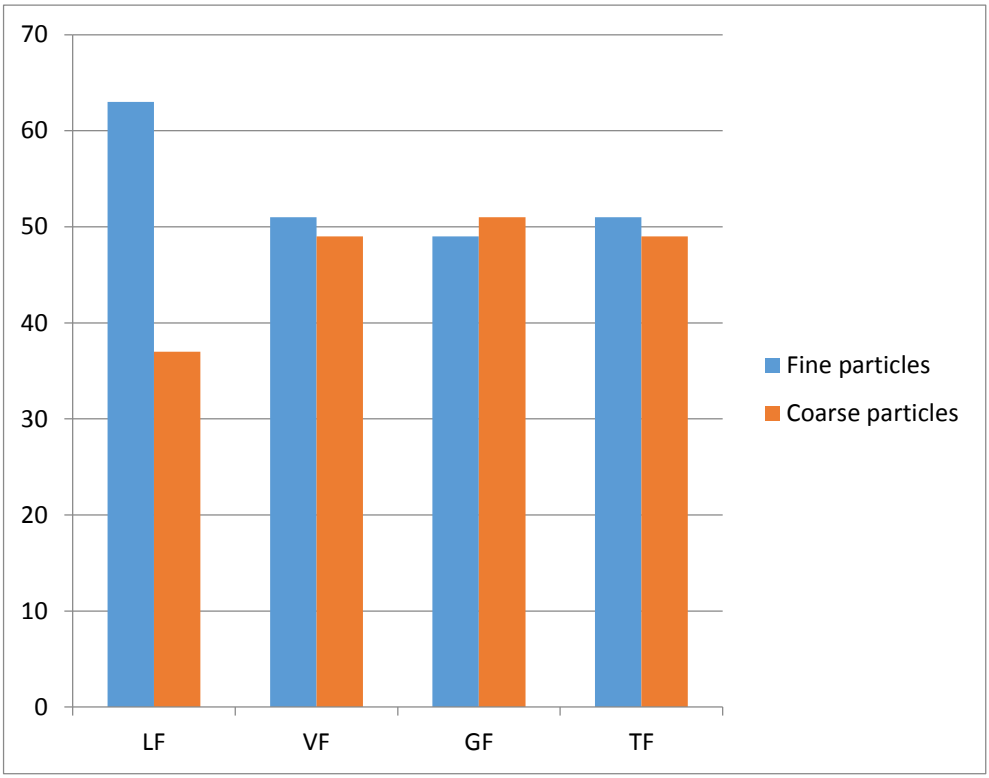

Fig. 1: Percentage distribution of fine and coarse portions of broiler starter rations.

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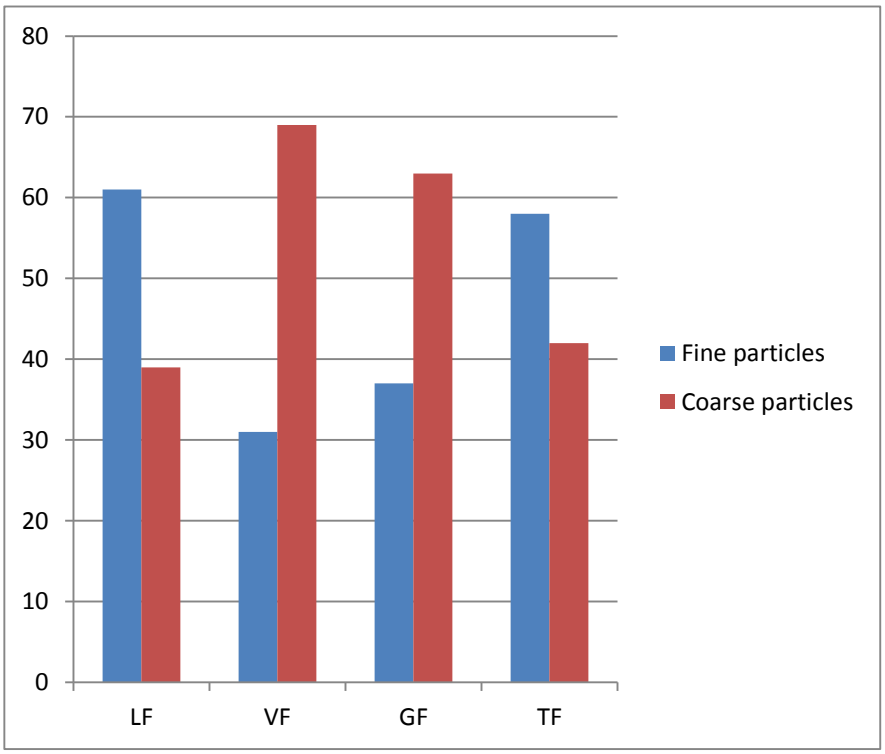

Fig. II: Percentage distribution of fine and coarse portions of broiler finisher rations.

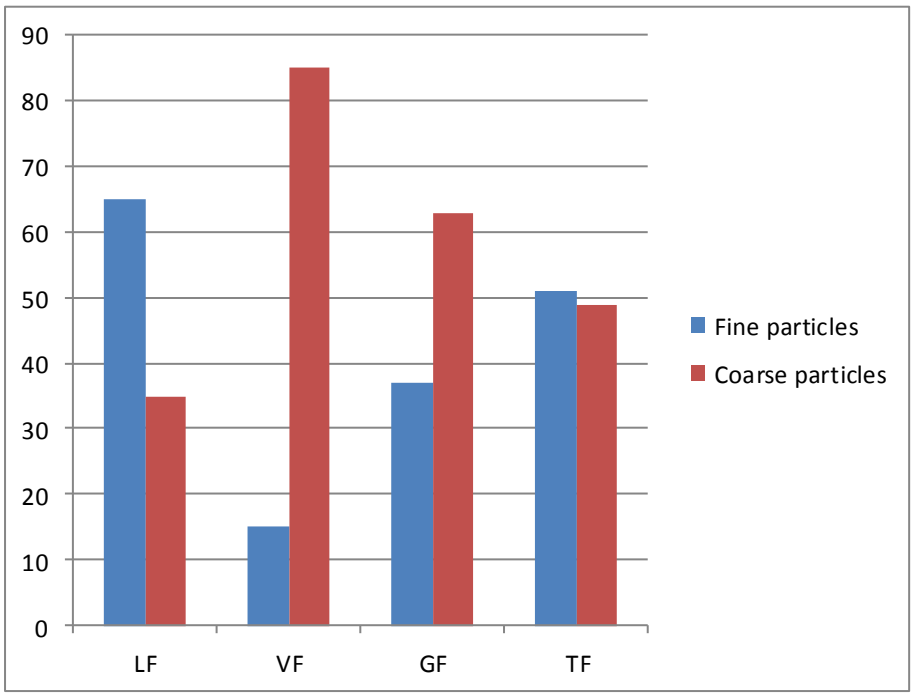

Fig. III: Percentage distribution of fine and coarse portions of Grower mash rations.

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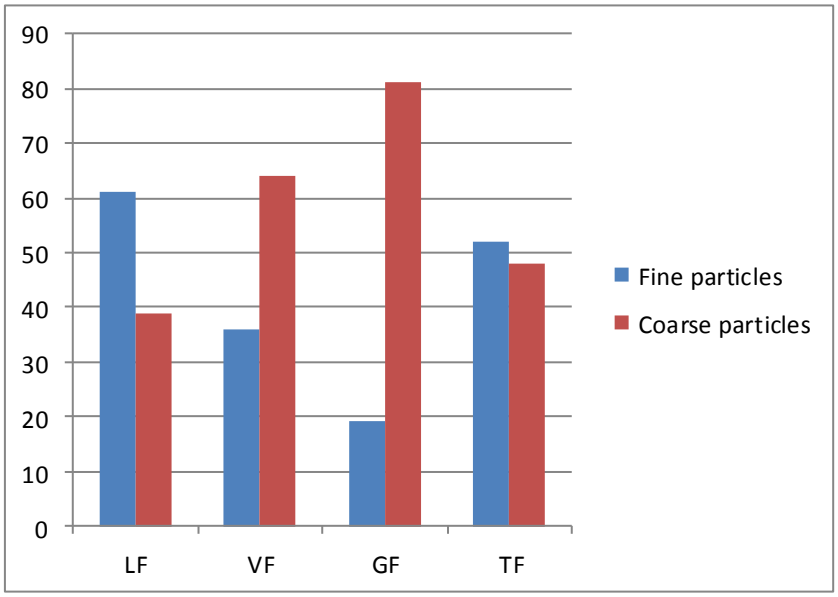

Fig IV: Percentage distribution of fine and coarse portions of Layer mash rations.

Results and discussion

Moisture content: The percentage moisture content of the commercial poultry feed brands (LF, VF, GF and TF) were presented in Table 2. Even though, significant differences were recorded in the percentage MC of some of the samples, the range of 8.87 – 11.72 % recorded in this study is well below the recommended optimal values of 12 – 14 % under tropical conditions [13, 14]. This result indicates that these feeds in their observed moisture conditions will store well and will not be subject to fungal attacks under the hot humid tropical conditions of south eastern Nigeria.

Earlier studies by [15] reported percentage moisture contents of up to 19 % in some commercial feeds produced in Nigeria, and concluded that such feeds reflect ethical and animal health risks to farmers who use such feeds to feed their animals [16].

Moisture content of feed is an important economic and health factor in poultry production because of the role moisture plays in the establishment and sustenance of microbial populations in the feed substrate. This is critical in developing countries like Nigeria, where feed quality remains outside the control of the poultry farmer [15]. Thus, issues of poor quality feeds that have direct or indirect bearings on percentage moisture are consistently reflected by the frequency of isolations of microorganisms of economic and health importance from these feeds produced in Nigeria [17, 18, 19].

Feed particle size: Table 3 represent data on percentage distribution of the particle sizes of some commercial feed types and brands produced in Nigeria. The particle sizes ranged from 7 - 42, 9 - 57, 7 - 75 and 5 – 62 % in the broiler starter (BS), broiler finisher (BF), growers mash (GM) and layers mash (LM), respectively. Currently in Nigeria, physical qualities of commercial feeds are not regulated. Feed quality regulatory bodies in the country have been silent over what is considered an important issue which has been implemented in several parts of the world [20, 8].

Table 3 and Figure 1 showed that LF broiler starter was more of the fine PS (<1.00 – 1.18 mm) than coarse PS (63.0 and 37.0 % respectively). The other three brands had evenly distributed PS of 49.0 – 51.0 % across fine and coarse types. This should be expected for VF and GF being pelleted diets that may need further crumbling to determine actual particle sizes of materials used in the feeds. However, the even distribution of PS seen in TF (mash) may negatively influence its intake by very young chicks, especially when 32.0 % of the feed fell to the very coarse portion of >2.00 mm. Similarly, the 34.0 % very fine (<1.00 mm) portion of LF may also present some difficulty in feed uptake, especially in situation where feeding trough distribution is very poor and late feeders are forced to consume very dusty remnants.

Birds select feed materials according to particle size [21]. It is important to note that young birds can not eat very large particle size as their beak is still small. The mechanoreceptors located at the beak of birds are used to distinguish the differences in PS [22]. Young birds in the first three weeks can be fed fine particles (0.57 –

ISSN: 0975 - 4539
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0.67mm), but as the birds get older, PS of the diets needs to be increased [4].

Table 4 and figure II showed the percentage distribution of PS of broiler finisher rations. The mashes, LF and TF had much higher fine PS portions (61.0 and 58.0 %) than their coarse portions, while it was the opposite (69.0 and 63.0 %) for the pelleted brands (VF and GF). Again, it is clear that LF and TF broiler finishers are not ideal and reflects the lack of standards in the physical characteristics of commercial poultry rations produced in Nigeria [16, 19]. It is expected that the PS of feeds should increase as the birds increase in size, since too fine particles could predispose birds to gizzard ulcerations [11]. There is therefore the need to regiment the actual PS for different age groups in the Nigerian poultry industry.

In Table 5, LF at <1.00mm and 1.18mm PS were similar ($P>0.05$), and significantly ($P<0.05$) higher than the values at 2.00mm and >2.00mm, which were similar ($P>0.05$). VF and GF at <1.00mm, 1.18mm and 2.00mm were similar ($P>0.05$), but significantly ($P<0.05$) lower than their value at >2.00mm PS. TF at <1.00mm and 2.00mm PS were similar ($P>0.05$), but significantly ($P<0.05$) lower than TF values at 1.18mm and >2.00mm PS, which were similar ($P>0.05$).

Table 5 and Figure III showed the percentage PS distribution of grower rations. LF brand maintained the earlier trend of having excessively fine PS (65), while VF recorded a disproportionately high 85 % coarse PS. Since there is only one grower feed type for birds from 18 – 20 weeks of age in the Nigerian market, such highly coarse pellets as produced by VF may present some difficulties in intake by birds at the early stages (8 – 10 weeks) of the grower period. A higher percentage of fine at the expense of the coarse as shown in GF may be more optimal. Similarly, growing birds on LF type of feed may not perform well considering the fine particle size in the feed. Since the birds are growing, the particle size is supposed to increase from <1.00mm and 1.18mm to 2.00mm and >2.00mm PS.

Table 6 and Figure IV present the percentage PS of the different commercial feeds for layers mash. Good uniformity of PS has been reported to influence the performance of birds. Again LF showed disproportionately high fine portion indicating that the company maintains the same PS for all types of feeds (63.00, 61.00, 65.00 and 61.00 % fine) analyzed in the present study. Some semblance of uniformity was maintained across all feed types by the TF brand (51:49, 58:42, 51:49 and 52:48 fine and coarse, respectively). These figures again suggest that averagely the same particle sizes are also maintained by this brand for all feed types. The 81.00 % coarse recorded for GF may be adequate since laying birds are matured and can break down the pellets. Again, during hot periods such large pellets could be used to induce increased feed intake in laying birds [14]. The improvement in performance with feed PS and uniformity is explained by the lower energy output birds make when they ingest bigger particles [8]. The number of pecks to eat a given amount of feed is reduced when PS increases [23].

CONCLUSION

The results of this study approved the percent moisture content of the commercial feeds evaluated. It also drew attention to percentage particle sizes of feed as a measure of quality. LF and TF which are mashes did not show significant variations in the particle sizes of the different feed types studied. There is the need therefore for feed standard regulators in Nigeria to heed the recommendation by [24] to also consider particle sizes of feeds as a routine quality control measure, and incorporate it in on- farm quality control programs.

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